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## Intelligence Report

Office of Transnational Issues

22 June 1998

**Subject: China: Scenarios of Long-Term Oil Consumption**

We have examined three scenarios for China's long-term oil consumption that vary key assumptions of GDP growth, real oil prices, and vehicle ownership as China's economy matures. The scenarios allow us to examine broad trends and to assess the implications of different oil consumption paths through 2015.

- *Our reference case--which is in line with most industry and government studies--projects consumption in 2015 at more than double current levels, reaching about 9 million barrels per day (b/d).*
- *In our low consumption case, China suffers from a deep and prolonged economic crisis in Asia, which lowers oil demand in 2015 to 7.3 million b/d.*
- *A takeoff in vehicle ownership and a significant increase in demand for transport fuels--similar to what happened in Taiwan and South Korea--is the basis of our high demand scenario in which oil consumption increases sharply to about 14 million b/d between now and 2015.*

In all scenarios China becomes increasingly dependent on oil imports to meet its needs because of the country's bleak oil production prospects. China currently produces about 3.2 million b/d.

- *China has not found sufficient new oil reserves to substantially boost stagnant domestic oil production, and exploration in the highly touted Tarim Basin and in offshore areas generally has been disappointing.*
- *China will rely heavily on Persian Gulf suppliers for its imports, which may induce Beijing to step up its foreign search for oil, thereby increasing competition for US firms in areas such as the Caspian.*

China's growing oil import requirements will play an important role in future oil price trends. We have assumed some strengthening of world oil prices in our high demand scenario to take account of China's growing import needs.

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- *There could be even more upward pressure on oil prices, however, if oil supplies are tighter than most industry experts expect in 2015.*

Higher oil use in China has serious environmental consequences. *Carbon emissions from road transport would double between now and 2015 under our reference case and increase ninefold--from 33 to 290 million tons--under our high demand scenario.*

investment opportunities could be substantial over the next decade as China looks for tens of billions of dollars in foreign investment for building and upgrading refineries and for oil exploration and development to meet its expected oil consumption needs.

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## Recent Slowdown in Demand After Strong Growth [ ]

China's oil consumption has grown steadily over the past decade along with the country's strong economic performance, and China is now the world's third largest oil-consuming country behind the United States and Japan.<sup>1</sup> Oil consumption increased on average 5.7 percent annually over the past 10 years, going from 2.2 million barrels per day (b/d) in 1987 to 3.9 million b/d last year, while GDP growth averaged about 10 percent annually over the period.

- A driving force behind China's robust oil consumption has been strong demand for transport fuels, which at 1 million b/d in 1996 accounted for about 30 percent of total oil demand (see Figure 1). The number of vehicles in China increased from 5.8 million in 1990 to 10.4 million in 1995, the last year for which complete data are available.
- Industry's oil use grew from 600,000 to 900,000 b/d from 1986-1996, mainly because of strong demand for oil feedstocks in the petrochemicals and chemicals industries.
- We estimate China's income elasticity of oil demand at 0.6 during 1987-1997, which is below the 1.0 or higher ratio for most developing countries. China's low income elasticity of oil demand reflects an emphasis on coal in its energy mix. [ ]

This year China has seen its economy and oil demand growth slow largely because of Asia's regional economic crisis; GDP growth slowed to 7.2 percent in the first quarter of 1998, down from 9.6 percent in first quarter 1997, according to Chinese press reports.

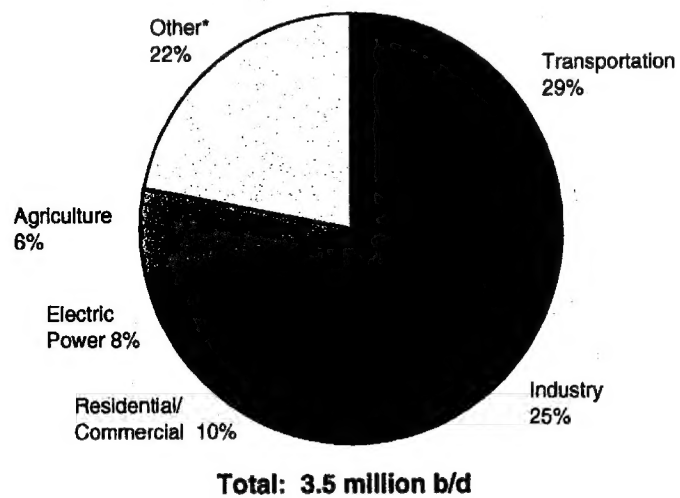
- If China's GDP growth rate remains at 7 percent this year, oil demand would register a 5-percent increase this year, compared with growth of about 9 percent in 1997, assuming an income elasticity of oil demand of 0.7.<sup>2</sup>
- [ ] sluggish oil demand and burgeoning inventories of unsold oil recently forced the China National Petroleum Corporation (CNPC) to announce a 5-percent cut in oil production--about

<sup>1</sup> For the purpose of this paper, the term *consumption* refers to *apparent consumption* or production plus net imports and is used interchangeably with the term *demand*. [ ]

<sup>2</sup> The 10-year average income elasticity of oil demand in China has risen over time from 0.2 in 1987 to 0.6 in 1997, and an income elasticity of oil demand in 1998 of 0.7 reflects the recent trend. [ ]

Figure 1

## China: Oil Consumption by Sector, 1996



\*Includes nonenergy use such as lubricants and refinery losses.

Source: International Energy Agency.

about 150,000 b/d. CNPC also has had to cut salaries, postpone salary payments, and lay off oilfield workers to control costs.

The average world oil price has dropped by more than \$3 per barrel since the beginning of the year, making crude oil imports cheaper than price-controlled domestic supplies; China's crude imports rose to about 650,000 b/d during the first quarter, up from year-earlier levels of 590,000 b/d. China recently announced that it will peg future prices for domestically produced crude oil and products to world oil prices to halt the influx of cheap imports.

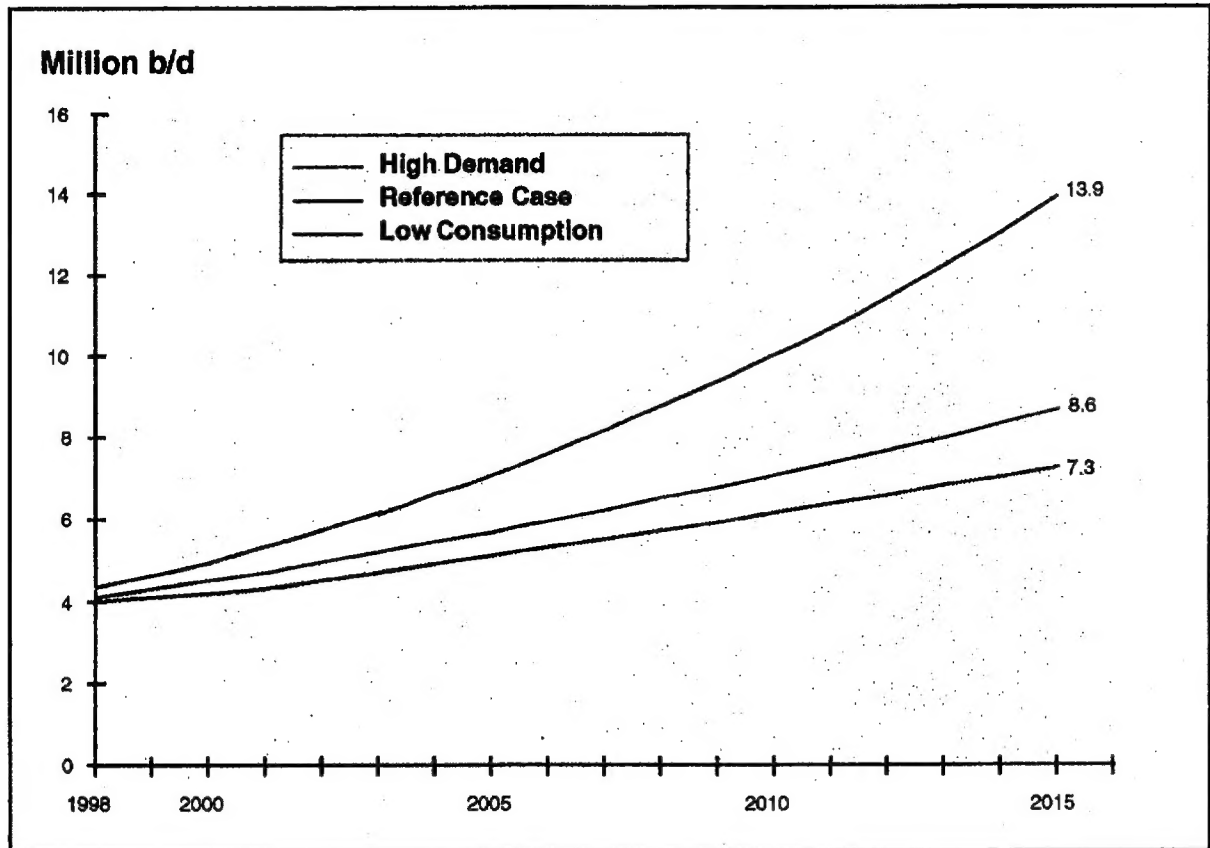
### Scenarios of Demand Over the Longer Term

We have examined three scenarios for long-term oil demand in China that vary the assumptions for average annual GDP growth, real oil prices, and the demand for transport fuels: a *reference case* in which China's economy weathers the Asian economic crisis this year and is able to avoid a slowdown in the medium term; a *low consumption* scenario in which China's economic growth slows as a result of a deep and prolonged crisis in Asia; and a *high demand* scenario in which China's GDP growth remains the same as in the reference case but demand for transport fuels grows well above our reference case because of a takeoff in vehicle ownership as the economy matures. We have assumed an increase in real oil prices from \$13 per barrel (1998 dollars) to \$21.50 per barrel between now and 2015 in the reference case and a moderately higher real oil price increase to \$24 per barrel (1998 dollars) under the high demand case, which takes into account China's growing import needs (see Figure 2). These real price assumptions imply that world oil supplies will meet increases in Chinese demand. Our scenarios are meant to be illustrative of key variables, not exact forecasts.

- In our *reference case*, China's GDP growth does not slow further because of the regional economic crisis, and the other Asian economies begin to recover in 1999. Under this scenario, we assume China's GDP grows at an average annual rate of about 7 percent between now and 2015. As a result, the country's oil consumption more than doubles, from about 4 million b/d in 1997 to 8.6 million b/d in 2015; demand for transport fuels remains at about a third of total demand in this scenario, and industry's share grows from 26 to 30 percent, reflecting the continued importance of oil feedstocks to industrial production. Our reference case is consistent with other US Government and industry forecasts, which put China's oil consumption at close to 7 million b/d in 2010, increasing to about 9 million b/d in 2015 (see Figure 3). It contrasts sharply, however, with public projections by a senior Chinese oil official who said Chinese demand will be closer to 5 million b/d in 2010, 2 million b/d lower than in our reference case.

Figure 2

## China: Oil Demand Scenarios, 1998-2015



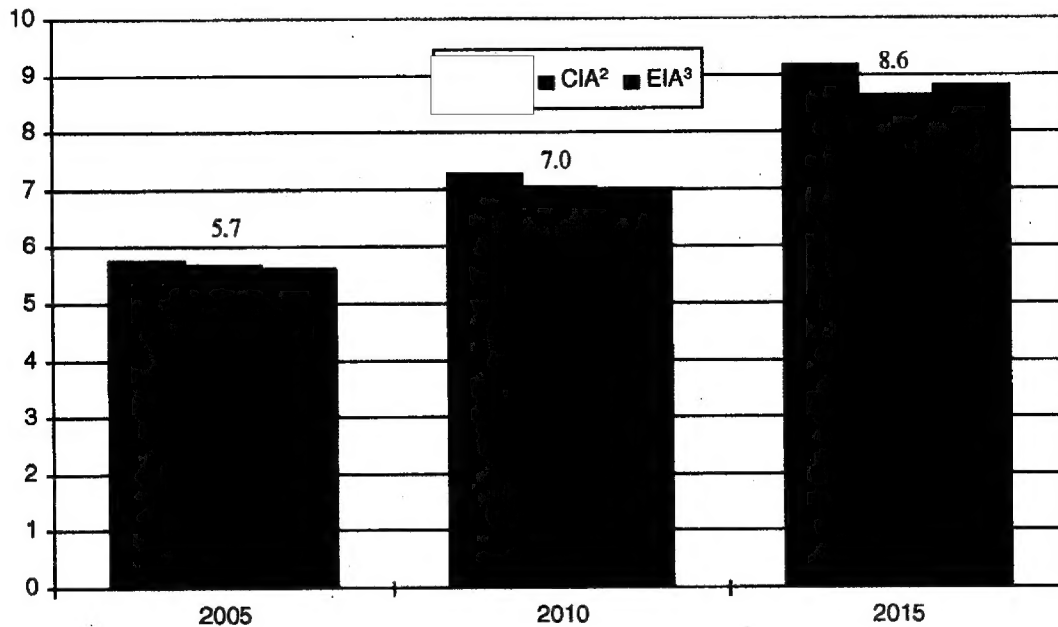
### Key Assumptions

	Low Consumption	Reference Case	High Demand
Average Annual GDP Growth Rate	5%	7%	7%
Income Elasticity of Oil Demand	0.7	0.7	Increases gradually from 0.7 to 1.1, reflecting increased oil intensity.
Real Oil Prices	Same as reference case.	Real oil price increase from \$13 per barrel (1998 dollars) to \$21.50 per barrel (1998 dollars) in 2015.	Real oil price increase from \$13 per barrel (1998 dollars) to \$24 per barrel (1998 dollars) in 2015.

Figure 3

## Forecasts of China's Long-Term Oil Consumption

Million b/d



2. Our reference case assumes a relatively low income elasticity of oil demand of 0.7.  
3. Energy Information Agency, US Department of Energy.

- Our *low consumption scenario* assumes the Asian economic recovery takes longer and that China is not immune from the slowdown. In this case, we assume lower average annual GDP growth of about 5 percent, which cuts average annual oil demand growth to 3.5 percent, or to 7.3 million b/d in 2015.
- Under a *high demand case*, the Asian crisis has only a minimal impact on China's economic growth and the transportation sector experiences rapid development similar to what happened in Taiwan and South Korea. In this scenario, we assume that as per capita GDP increases from its current level of about \$3,500 (purchasing power parity) to \$9,500, vehicle ownership per 1,000 people follows a similar path to that in Taiwan and South Korea, and vehicle ownership per 1,000 people tops 110 by 2015, more than four times what it would be in our reference case (see Figure 4). Under these circumstances, demand for transport fuels could be 8.2 million b/d in 2015, pushing total oil consumption to about 14 million b/d.<sup>3</sup> The higher Chinese demand, together with anticipated consumption growth elsewhere in the world, causes real oil prices to increase to \$24 per barrel in 2015, and income elasticity of oil demand would rise from 0.7 to about 1.1, more typical of ratios in developing countries and reflecting a pattern of rising oil demand to GDP growth over the past decade in China.

#### Bleak Domestic Oil Supply Outlook

In contrast to growing oil demand, China's oil production has increased by less than 2 percent a year in 1987-1997, according to official Chinese statistics. China has not found sufficient new oil reserves to substantially boost domestic production that averaged some 3.2 million b/d last year, and recent exploration activity has been disappointing.

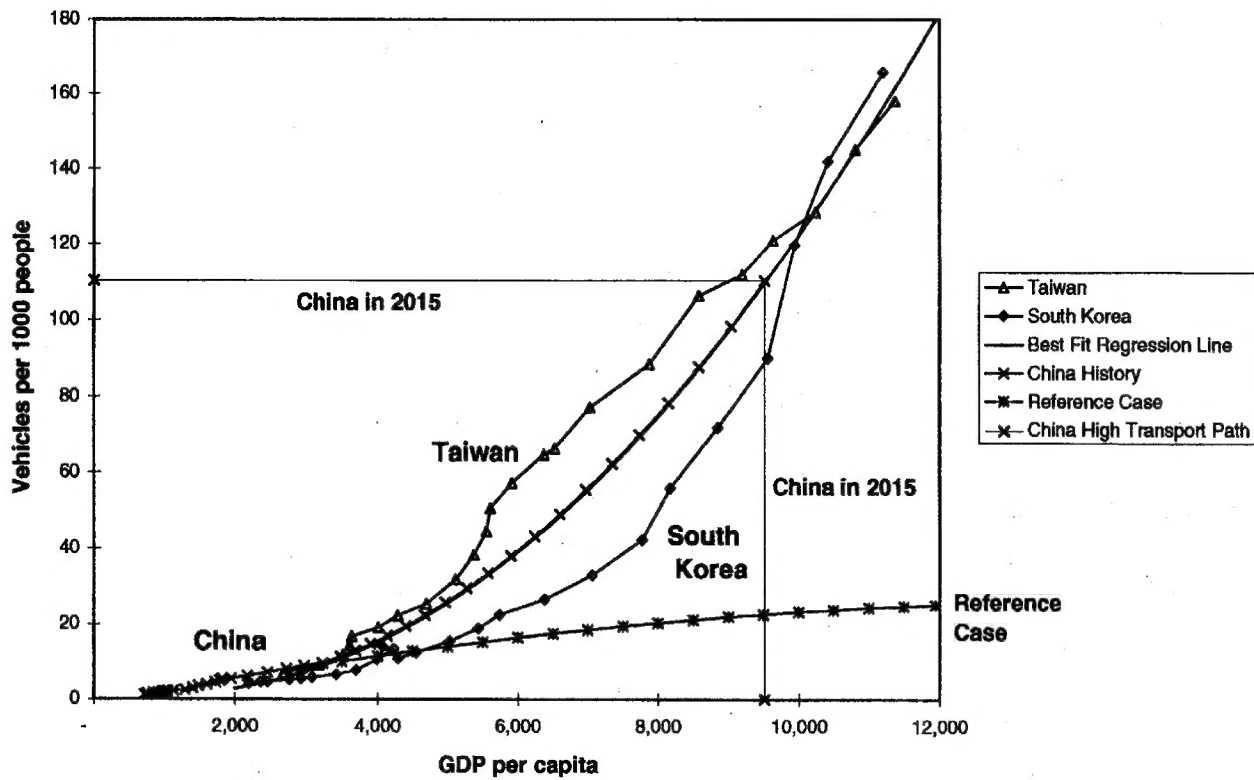
- Production from the country's three aging onshore fields--Daqing, Shengli, and Liaohe, which account for about 65 percent of total output--declined in 1996, according to a CNPC report. Press reports citing attempts at Shengli to slow the rate of decline and similar pronouncements about efforts at Liaohe to maintain current production rates suggest that the downward trend in output from these fields continued in 1997.
- Chinese exploration of the Tarim Basin in Xinjiang Province, which many Chinese and foreign geologists believe has the country's "last, best chance

<sup>3</sup> Even this number assumes a major reduction in fuel use per vehicle in China--from 26 barrels per vehicle currently to 17 barrels per vehicle by 2015. Fuel use per vehicle in China is likely to decline over time because of a combination of factors, including a lower proportion of trucks, lower intensity of vehicle use, and higher vehicle efficiency.



Figure 4

**Evolution of Vehicle Ownership with GDP  
in Taiwan, South Korea, and China**



Source: Motor Vehicle Facts and Figures, IEA,

for large undiscovered fields" has not been successful. Most major foreign oil companies suspended exploration in late 1996 citing poor results from exploratory drilling and Chinese bureaucratic impediments, according to press reports.

- Exploration elsewhere in China has also been a disappointment. Offshore production in the South China Sea, which represents about 90 percent of China's total offshore output of about 300,000 b/d, is at its peak level and will begin to decline in a few years unless large new fields are discovered,

Imports, as a result, have been rising. Last year China's net oil imports were some 700,000 b/d, twice 1996 levels, of which more than half were refined products. Crude oil imports came mainly from suppliers in the Persian Gulf, Southeast Asia and Africa. Meanwhile, Beijing turned to Kazakhstan, Iraq, and Venezuela in a search for secure, long-term oil supplies.

- Last year CNPC signed two oilfield development deals with Kazakhstan that reportedly include construction of a \$3.5 billion, 3,000-kilometer pipeline to western China. Progress on the proposed pipeline is uncertain, however, and the project has moved little beyond a recent announcement by Kazakhstan's President Nazarbayev that a "final" agreement will be signed soon.
- China also has signed a \$1.2 billion postsanctions production-sharing deal with Iraq to develop the Ahdab field and two, 20-year contracts to develop fields in Venezuela, an investment of about \$350 million.
- CNPC has smaller development deals in Peru and Sudan and is pursuing projects in Canada, Russia, Thailand, Papua New Guinea, and Mongolia.

China hopes its overseas ventures can deliver 400,000-500,000 b/d by 2000 and 1 million b/d by 2010, according to press reports. These volumes, however, will not be sufficient to meet China's oil requirements which we estimate at some 6-10 million b/d in 2010 (see Table 1). If domestic oil production remains around 3 million b/d at that time, China's oil import requirements from the spot market would be 3-7 million b/d by 2010; this would represent 30-70 percent of consumption needs under our high demand case.

**Table 1**  
**Chinese Oil Demand Scenarios**

	(Million b/d)				
	<u>1998</u>	<u>2000</u>	<u>2005</u>	<u>2010</u>	<u>2015</u>
Low Consumption*	4.0	4.2	5.1	6.1	7.3
Reference Case**	4.0	4.5	5.7	7.0	8.6
High Demand***	4.3	4.9	7.0	10.1	13.9
<b>Range of Estimated Oil Demand</b>	<b>4.0-4.3</b>	<b>4.2-4.9</b>	<b>5.1-7.0</b>	<b>6.1-10.0</b>	<b>7.3-13.9</b>
<b>Domestic Production</b>	<b>3.2</b>	<b>3.2</b>	<b>3.2</b>	<b>3.0</b>	<b>2.5</b>
<b>Implied Import Requirements</b>	<b>0.8-1.1</b>	<b>1.0-1.7</b>	<b>1.9-3.8</b>	<b>3.1-7.0</b>	<b>4.8-11.4</b>

\* Assumes average annual GDP growth of 5.0 percent, a real oil price increase from \$13 per barrel (1998 dollars) to \$21.50 per barrel (1998 dollars) between 1998 and 2015, and an average income elasticity of oil demand of 0.7.

\*\* Assumes average annual GDP growth of about 7.0 percent, with real oil price increases and income elasticity of oil demand the same as in the low consumption case.

\*\*\* Assumes average annual GDP growth of 7.0 percent, with a gradual increase in income elasticity of oil demand from 0.7 to 1.1 over time as oil intensity increases. Assumes moderately higher real oil price increase than in the reference case--from \$13 per barrel (1998 dollars) to \$24 per barrel (1998 dollars) between now and 2015.

## Implications of Robust Oil Consumption

Prospects for strong oil demand as China's economy continues to mature coupled with a poor outlook for a big upturn in domestic production and supplies from overseas ventures will mean that China will be increasingly dependent on oil imports--particularly from the Persian Gulf region. Nearly half of China's crude oil imports of about 600,000 b/d last year came from Oman, Iran, Saudi Arabia, and Yemen,

- Beijing is looking to Iran and especially Iraq to supply much of its future oil import needs. Iran is slated to increase its crude shipments to China from 120,000 b/d last year to 200,000 b/d in 1999; the increase may come from an expected boost in offshore production.
- China hopes to be a major foreign producer in Iraq once economic sanctions are lifted, according to industry press reports. The Persian Gulf region could supply more than 90 percent of China's crude oil imports by 2015,

China's foreign search for long-term oil supplies probably will continue and may intensify given the country's bleak domestic production outlook, and US firms could face increasing competition from CNPC in areas such as the Caspian.

- If Beijing is willing and able to provide financial support to CNPC for these ventures, the company would be a formidable competitor. A US firm lost its bid to develop Kazakhstan's Aktyubinsk field to CNPC, in part because CNPC came armed with a signing bonus of \$365 million.

China's growing oil import requirements will play an important role in future oil price trends. Our scenarios assume that world oil prices do not increase substantially--a view shared by market experts who project supplies will be adequate to meet world demand over the next 15 years with only moderate growth in oil prices. Their outlook assumes substantial capacity increases in the Middle East and Caspian Basin.

- There could be even more upward pressure on oil prices, however, if oil supplies are tighter in 2015 than most industry experts anticipate.
- Sharply higher oil prices, combined with other factors such as the elimination of oil price subsidies, lack of infrastructure development, restrictions on vehicle ownership, or technological improvements, would work to dampen oil consumption growth in China and elsewhere to keep

the market balanced (see Text Box: Other Factors That Could Lower Oil Demand).

Substantially higher oil use in the transportation sector would have serious environmental consequences.

- If demand for transport fuels tops 8 million b/d in 2015 as we project in our high demand scenario, China's carbon emissions from road transport would increase nine times--from 33 to 290 million tons, closing in on the current US level of 450 million tons, according to our estimates. Even in the reference case, carbon emissions are twice current levels.
- Increased emissions from Chinese vehicles, coupled with projected large increases in emissions from growing coal use, would be a severe setback to international efforts to control CO<sub>2</sub> emissions.

investment opportunities in China's oil sector over the next decade could be substantial, especially for additions and upgrades to refining capacity. Moreover, investment opportunities in China's upstream sector will likely improve as concerns about its eroding energy security induce Beijing to seek foreign help for indigenous oil exploration and development.

- China will need to build 7 million b/d of refining capacity between now and 2015--nearly twice its current level--to ensure higher output of transportation fuels and will have to upgrade refineries nationwide to handle expected large volumes of high-sulfur Middle East crudes. China will also need more pipelines to move products to distribution centers. Overall investment in the refining sector could reach \$80 billion by 2015, \$16 billion of which is expected to come from foreign sources.
- In March 1998, CNPC announced plans to open new areas in the west and northeastern regions to "cooperative enterprises" with foreign companies. According to press reports, China currently has more than 150 exploration, development, and service contracts with foreign oil companies, worth more than \$6 billion, and recent oil industry reform in China is designed to make the investment climate more attractive to foreigners.

TEXT BOX

Other Factors That Could Lower Oil Demand

Our projections do not take into account the following factors that would dampen Chinese oil demand and lower our consumption estimates.

**High real oil prices.** China's oil demand in 2015 would be lower than we currently estimate with higher real oil prices. For example, if real oil prices rise to \$35 per barrel in 2015--compared to \$21.50 and \$24 per barrel in our reference case and high demand scenario, respectively--Chinese oil consumption would be 700,000 to 1 million b/d lower.

**Elimination of oil price subsidies.** China recently announced that it has decided to eliminate price subsidies on domestically produced crude oil and products and will peg future prices to market oil prices. Gasoline prices have been about 5 percent lower than in the United States, while diesel prices were about 20 percent lower because of price subsidies.

**Lack of infrastructure development.** Road infrastructure is a key factor in demand for transportation fuels, and a slow pace of roadbuilding could slow oil consumption growth in the transportation sector and reduce per capita oil use. China's per capita oil consumption already is low--1 barrel (42 gallons), compared with about 25 barrels (1,015 gallons) per capita in the United States.

**Restrictions on vehicle ownership/imposition of fuel taxes or rationing.** A policy by Beijing to curb vehicle ownership or impose gasoline taxes or rationing would slow demand for transport fuels. Such policies, however, would face stiff opposition, according to an industry expert. A recent Chinese magazine survey found that 75 percent of Beijing's families plan to buy a car within the next five years.

**Technological improvements and efficiency gains.** Aggressive pursuit of new, energy-efficient technologies for motor vehicles, aircraft, industrial boilers, electricity generation, and petrochemical processes would help slow oil consumption.

there is considerable potential for efficiency gains, particularly in the transportation sector, where consumption of diesel fuel is about 30 percent higher per vehicle mile than in developed countries. Vehicles in China currently use an average of 26 barrels per year, compared to 15 barrels of oil per year in the United States, although the higher average in China partly reflects a higher proportion of trucks.

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